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# Nutritional Status and Mortality of Highland Children in Nepal: Impact of Sociocultural Factors

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*ABSTRACT* This study investigates the nutritional status of native children in the highlands of Nepal (1,700–3,000 m) and explores the relationship between child mortality and surviving children's nutritional status. A random sample of 145 households from 11 villages in the Koshi Hill Zone in east Nepal was surveyed, and the nutritional status of the 438 children <14 years of age living in these households was assessed by means of anthropometry. We found a severe growth retardation in the Nepalese children compared to lowland reference groups as well as to highland children from the Andes. Child mortality and altitude are not significantly different between higher (Brahman and Chetri) and lower (Baisya and Sudra) caste households. A lower caste status and higher altitude of the household is associated with a significantly better nutritional status in offspring. In multiple regression analyses, improved nutritional status in children is significantly associated with lower caste ($P = 0.001$), higher altitude ($P = 0.009$), and less crowding ($P = 0.001$) but not with sibling mortality ($P = 0.11$). We thus conclude that nutritional status of children in households in the highlands of Nepal is associated with the household's socioeconomic status and altitude but not with mortality among siblings. 

The debate on physical growth patterns of humans living at high altitude has mainly focused on the relative importance of high-altitude hypoxia and nutritional scarcity as contributors to the growth retardation observed in highlanders, particularly in the Andes. In this paper we focus on interactions between sociocultural factors affecting nutritional status of highland children in Nepal.

Early studies on physical growth of indigenous peasant children living at high altitude in the Peruvian Andes (altitude 3,800–5,500 m) reported a profound delay in growth (Frisancho and Baker, 1970; Beall et al., 1977). More recent research (Stinson, 1980; Greksa et al., 1984, 1985; Gonzales et al., 1982; de Meer et al., 1993b) confirmed the relationship between altitude and growth retardation in Andean children living at 3,800–4,000 m but indicated less severe growth retardation than the earlier studies. Also, children living at 2,250 m in the United States were shown to have a moderate reduction in height for age (of 0.3 z score; National Centers of Health Statistics

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(NCHS) reference) in comparison to their lowland peers (Yip et al., 1988). Although the authors of the latter study did not discard the possibility that reduced nutrition occurred in the populations at higher altitude, the subjects studied had access to health care and nutritional supplementation. Those observations suggest that a hypoxic environment per se causes a moderate reduction of linear growth in children born at high altitude.

Malnutrition has been found to affect seriously children's health in rural lowland as well as highland areas in many parts of the world (Wood et al., 1987), and interactions between nutrition and socioeconomic and cultural factors thus remain important in the study of growth patterns in highland populations. In Nepal, one of the world's poorest countries, chronic and acute malnutrition in children are found throughout the country (English, 1981; Martorell et al., 1984; Adhikari, 1991). Estimates indicate that 50% of Nepal's children under 5 years of age suffer from severe or moderate malnutrition, and child mortality rates are among the highest in the world (UNICEF, 1985, 1992). Recently, research suggested that death of siblings may be another factor affecting children's nutritional status in nutritionally deprived highland populations. In the rural highlands of Peru (altitude 3,810–3,840 m) a positive association was reported between child mortality and the nutritional status in surviving siblings under 4 years of age (de Meer and Heymans, 1993). This association could not be explained by altitude or sociodemographical factors, and it was suggested that food availability and food distribution in the household could be critical factors (de Meer et al., 1993a). These findings could be useful for our understanding of differences in growth patterns in undernourished highland populations with high child mortality rates.

Our study is designed to explore the apparent link between child mortality and surving children's nutritional status in Himalayan native populations. Previous studies on peasant children (Sherpa and offspring of Tibetan migrants) living in the Himalayas in Nepal found no evidence of a more severe growth retardation in highland children than in their lowland counterparts (Gupta and Basu, 1981; Pawson, 1977), but no information on child mortality or sociocultural factors (e.g., caste) on the household level was given. Thus, we aim to investigate the relationship between mortality and growth patterns of children in households in the rural highlands of Nepal, and we explore the effects of socioeconomical factors (e.g., caste) and altitude as well.

## SUBJECTS AND METHODS

### Research location

Data acquisition took place between July and October 1992 in the Koshi Hill Zone (size approximately 6400 $km^2$) in east Nepal. This region is part of the rugged Himalayan foothills located south of the divide between Mt. Everest (8,848 m) and the Kangchenjunga (8,598 m, near the Nepal-Sikkim border). The climate south of the Himalaya water divide is monsoonal; 70% of the yearly rainfall is received between June and September. The area where the study was conducted was the rural part of the center of this zone and consisted of parts of the districts of Dhankuta, Shankwabasa, and Terathum (in 1991, total population in these districts including the town of Dhankuta was 391,000). The rural Koshi Hill area is accessible only by foot (from the town of Dhankuta, which has road connections with Kathmandu) and has a mean altitude of 2,200 m (range 1,700–3,000 m).

The majority of the population in this area subsists by small, mixed farming. Rice, maize, and potatoes are staples. Most families are Hindu and a few are Buddhist. The caste system, derived from the religious and social classification of traditional Indian society, is manifest in four strata which are classified by the population from highest to lowest as Brahman, Chetri, Baisya, and Sudra. Caste ascription implies differences in socioeconomic status and customs, most notably between the Brahman and Chetri at the one hand and the Baisya and Sudra at the other.

Several health posts in the research area offer basic care (no doctors are available; medicinal supplies appear to be short) and could be reached within a few hours by foot. To

reach the nearest district hospital would take at least 2 days of walking. In the villages latrines were lacking in many houses. Many households could obtain drinking water from open wells only.

### Sample and measures

In the central Koshi Hill area, 17 villages located at altitude >1,700 m were identified. From these, 11 villages with comparable socioeconomical circumstances were selected with the aid of the director of the Health Center in Dhankuta. The altitude of each village was assessed with a Sanyo altitude meter (accuracy: 50 m). In each village permission was asked for the study. After consent was obtained, a random sample was taken from the village roster by drawing lots. From a total of approximately 1,000 eligible households in the 11 villages, 163 households were selected with children under the age of 14 years. From these, 13 households were not at home, and 3 refused to cooperate. In addition, two households were excluded from the present study, as not all children below 14 years could be measured. Thus, the final study sample consisted of 145 households.

All households were surveyed with a structured household questionnaire. This questionnaire was translated into Nepalese by a female interpreter, who was well acquainted with the regional culture and language. It contained questions on 1) the number of household members (crowding), 2) the level of education of the spouses, 3) caste (and religion), 4) economic status (e.g., income, land tenure), 5) obstetric history of the mother, 6) the health status of offspring (including child mortality), and 7) the water supply.

In addition, all 438 children under 14 years of age were studied with anthropometry. Measurements were carried out (by J.L.M.H.) using standard methods, following the procedures described by de Meer et al. (1993b). Briefly, weight was measured to the nearest 0.1 kg and height, left upper arm circumference and head circumference to the nearest 0.1 cm. Triceps skinfold was measured with a Holtain caliper to the nearest 0.1 cm (Jeliffe, 1966).

### Data reduction and analysis

From the questionnaire, standardized mortality rates in offspring were calculated using internationally accepted definitions (W.H.O., 1977). Infant mortality was defined as deaths in children born alive, per 1,000 live births, in the first year of life (and subdivided into neonatal and postneonatal mortality). Child mortality was divided into deaths in children born alive, per 1,000 live births, between 1 and 4 years and between 5 and 13 years of age.

Nutritional status of children is defined as their physical growth status and indexed by five anthropometric parameters: height, weight, head circumference, mid upperarm circumference, and triceps skinfold. To evaluate the nutritional status, z scores (expressed in standard deviation scores [SDS]) were calculated from US (NCHS reference) and Dutch (Gerver, 1988) reference populations as previously described (de Meer et al., 1993b). The SDS of triceps skinfold for age was calculated from the reference data of the US National Health Examination Surveys (Frisancho, 1990). For some age groups, reference data were not available, and no z scores were calculated. Differences with regard to nutritional status differentials were evaluated by multivariate analyses of variance (MANOVAs) and factor analysis. In the MANOVA listwise deletion was used.

Crowding was defined as the number of children and adults living together in the household. The educational level of the household was defined as the highest number of years of formal education among the spouses (in most households, the father's). In the Hindu caste spectrum, from high caste to low caste (Brahman, Chetri, Baisya, and finally Sudra), most families in the area of research indicated that they belonged to the Chetri and Baisya caste. There were also a few Brahman and Sudra households. For the purpose of data analyses, the households were reclassified in dichotomized high (Brahman and Chetri) and low caste (Baisya and Sudra) categories. Only a few non-Hindu (i.e., Buddhist) households were encountered, and these were classified into the low caste category.

The household questionnaire contained

*TABLE 1. Z scores[1] of nutritional status parameters of 438 children in the Koshi Hill area in Nepal, according to age*

| | | Nutritional status parameters | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | HAZ | | WAZ | | ZTRIC | | ZHDCRC | | ZARMCRC | |
| Age (years) | n | Mean | (SD) | Mean | (SD) | Mean | (SD) | Mean | (SD) | Mean | (SD) |
| 0–0.49 | 17 | −0.4 | (1.1) | −0.2 | (1.1) | —[2] | —[2] | −1.1 | (0.9) | −1.6 | (0.9) |
| 0.5–0.99 | 20 | −1.6 | (1.1) | −1.9 | (0.9) | −1.1 | (0.6) | −1.8 | (0.9) | −3.2 | (0.7) |
| 1–1.99 | 35 | −2.5 | (1.3) | −2.4 | (0.9) | −0.9 | (0.6) | −2.7 | (0.9) | −3.5 | (1.1) |
| 2–3.99 | 112 | −2.4 | (1.1) | −2.3 | (0.9) | −0.9 | (0.6) | −2.2 | (1.0) | −3.1 | (0.8) |
| 4–13.99 | 254 | −2.4 | (0.9) | −2.1 | (0.7) | −1.2 | (0.3) | −2.0 | (0.9) | −2.9 | (0.7) |

[1] Z scores, expressed in SDS, for height (HAZ), weight (WAZ), triceps skinfold (ZTRIC), head circumference (ZHDCRC), and upper arm circumference (ZARMCRC).
[2] Reference data not available.

several items on the households' socioeconomical status (i.e., land property ($m^2$), education, and yearly cash income [in rupees]). The use of caste as an index of socioeconomical status was explored by comparing high and low castes in MANOVAs. Nutritional status and mortality between caste categories were explored with Student *t*-tests (*t* values and degrees of freedom (df) are indicated in the text). Pearson's correlation coefficients were computed to investigate the relationship between siblings' nutritional status and child mortality. A backward regression analysis was carried out to explore whether this relationship was independent of hygiene (i.e., crowding), socioeconomical status (i.e., caste), and altitude.

## RESULTS

### Nutritional status and mortality rates in children

Sample sizes, means, and standard deviations (SD) for anthropometric parameters are presented in the Appendix. According to the criteria of the World Health Organization for stunting (height for age z score $<-2$ SDS) and wasting (weight for height z score $<-2$ SDS), 268 (61%) of the 438 children in the sample are stunted, and 51 (12%) are wasted. Z scores for height and weight in the first half year are only a little below the mean of the reference populations (Table 1). During the second half of the first year however, a drop in the z score is observed for all parameters except triceps skinfold. A further decline is observed during the second year of life. After the second year the z scores remain approximately the same (Table 1). For all age cohorts, z scores are similar for boys and girls (F ratios <1, NS).

To compare the nutritional status in offspring of households in both caste categories, data for age cohorts are combined. A difference of 0.1–0.2 SDS occurs in nutritional status parameters between children in the high and low castes, indicating a better nutritional status in the latter group. A MANOVA indicated that the nutritional status of low caste children is significantly better than the nutritional status of high caste children (F ratio (5 nutritional parameters, df = 392) = 7.8; Hotelling, $P < 0.001$). Subsequent univariate analyses showed similar differences, with higher z scores in low compared to high caste children for weight [$t = -3.3$, $P = 0.001$], upper arm circumference [$t = -2.5$, $P = 0.014$], triceps skinfold [$t = -3.2$, $P = 0.001$], and head circumference [$t = -2.2$, $P = 0.03$].

The total number of births in the 145 households was 677. Of these, 107 had died during childhood. The male/female sex ratio in the sample is elevated (1.13 for births and 1.41 for the children who had died). Such deviance in sex ratios may indicate underreporting of female infant deaths and has been previously described in peasant populations in Turkey, the Peruvian highlands, and India (Aksit and Aksit, 1981; de Meer et al., 1993a); Das Gupta, 1987). The number of births and sex ratios are not different between the castes. Standardized mortality rates were higher in the lower caste households than in the higher caste households from the postneonatal period up to age 5 (Table 2), but differences were not statistically significant (Table 3).

### Caste and socioeconomical status

Table 3 depicts the descriptive statistics of three socioeconomic variables, altitude, and child deaths in high and low caste house-

*TABLE 2. Standardized mortality rates during childhood in the Koshi Hill area in Nepal according to caste*

| | Mortality rate per 1,000 live birhts (number of deaths/births) | | |
|---|---|---|---|
| | High caste (Brahman and Chetri) | Low caste (Baisya and Sudra) | Total |
| Neonatal (A) | 45 (15/337) | 50 (17/340) | 47 (32/677) |
| Postneonatal (B) | 30 (10/337) | 44 (15/340) | 37 (25/677) |
| Infant (A + B) | 74 (25/337) | 94 (32/340) | 84 (57/677) |
| Child (1 to <5 yrs) | 33 (11/337) | 50 (17/340) | 41 (28/677) |
| Child (5 to <14 yrs) | 15 (5/337) | 9 (3/340) | 12 (8/677) |

*TABLE 3. Descriptive variables for high and low caste households in Koshi Hill Zone in East Nepal (n = 143)*

| | High caste | | Low caste | | *t*-test | | |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | *t* | df | *P* |
| Education (years) | 6.3 | 3.7 | 5.1 | 3.2 | 2.0 | 143 | .04 |
| Amount of land ($\times 10^4$ m$^2$) | 1.2 | 1.1 | 0.8 | 1.1 | 1.8 | 143 | .06 |
| Altitude (m) | 2,117 | 251 | 2,125 | 272 | −0.2 | 143 | 0.8 |
| Income (rupees/year) | 5,630 | 6,094 | 6,462 | 7,747 | −0.7 | 143 | 0.5 |
| Amount of child deaths | 0.6 | 0.9 | 0.8 | 1.6 | −1.1 | 143 | 0.3 |

holds. A MANOVA including level of education, amount of land, and income indicated a significant difference between high and low caste households (F ratio = 2.7, $P < 0.05$). Hence, we consider caste an appropriate index of the household's socioeconomical position.

### Associations between child death, caste, altitude, and surviving siblings' nutritional status

A factor analysis (principal components analysis) was conducted to test whether the z scores of the five anthropometric parameters could be represented by one index of nutritional status. All variables loaded on the first factor (Eigenvalue 2.7, explained variance 54.6%; component loadings: height 0.76, weight 0.93, triceps skinfold 0.34, armcircumference 0.83, headcircumference 0.70). Hence, the sum score of the Z scores was used in the following analyses.

To test the null hypothesis concerning the child mortality and siblings' nutritional status, we performed a backward regression analysis with sum score of nutritional status as the dependent variable and number of dead siblings, caste, crowding, and altitude as independent variables. Results of the regression analysis are summarized in Table 4. In the stepward analyses, caste ($\beta = -0.2$), altitude ($\beta = 0.14$), and crowding ($\beta = -0.16$) are significantly associated with nutritional status. The negative $\beta$s indicate that higher caste and poor hygiene (i.e., more crowding) are associated with relatively lower summed z scores. The positive $\beta$ for altitude indicates that higher altitude was associated with higher summed z scores.

Correlations between nutritional status and the number of sibling deaths are small and not significant.

## DISCUSSION

In this study we explore nutritional status and mortality rates of native children living at moderately high altitude in east Nepal with the aim to test whether child death is associated with improved nutritional status in surviving siblings (de Meer et al., 1992; de Meer and Heymans, 1993). After correction for socioeconomic factors, no evidence emerged to support the idea that high rates of sibling mortality are associated with better nutritional status of surviving children. However, the results suggest that caste and altitude are of relevance for children's nutritional status.

### Nutritional status of highland children in Nepal: Comparisons with lowland and Andean populations

We found severe reduction in postnatal physical growth in the Nepalese children. Our findings are very similar to previous

studies in the Koshi Hill area (Habarro, 1984) and Terai region (Martorell et al., 1984) in Nepal. After the first year of life, large differences in anthropometric parameters occur between the Nepalese children and the US and Dutch reference populations living near sea level (difference: −2 to −3 SDS). The Nepalese highland children also have a decreased nutritional status when compared to highland children in Peru at 3,825 m, who were measured with identical methods (difference: −0.7 to −1.5 SDS [de Meer et al., 1993b]). Height of the Koshi Hill children is very similar to height in Quechua children in the Peruvian Andes (Nuñoa, altitude 4,000–5,000 m) measured in the early 1960s by Baker's group (Frisancho and Baker, 1970), but the Nepalese children in our study show persistent deficits in weight (ranging from 2–7 kg) compared to the early Nuñoa sample. Nowadays, the growth pattern of the Nuñoan children as reported by Frisancho and Baker is no longer regarded as representative for the native population in the Andes. Leonard (1989) showed that growth patterns of Nuñoan children in the 1980s were markedly improved over the earlier findings. The altitude of the villages selected for our study is moderate (1,700–3,000 m); thus, altitudinal hypoxia is a very unlikely explanation for the severe growth retardation of the Koshi Hill children.

## Nutritional status of children: Impact of socioeconomical factors

Altitude is associated with increased nutritional status in Koshi Hill children. This is in agreement with Gupta and Basu's findings (1981) on nutritional status among highland Sherpas in Upper Khumbu, Nepal (3,500–4,500 m), who were found to have a better nutritional status compared to migrants at lower altitudes (1,000–1,500 m). Although Gupta and Basu suggested that a higher prevalence in parasitic infections at lower altitude might account for their findings, data on parasitic infections were not systematically collected in their study and are also lacking in our study.

Caste (which was associated with education and land holdings) and crowding are associated with nutritional status of the Koshi Hill children, independent from altitude. Surprisingly, offspring in higher caste households have a diminished nutritional status compared to offspring in lower caste households. These results contrast with the results from Martorell and coworkers (1984), who found no associations between caste and offspring's nutritional status. The design of our study does not allow further exploration of the interactions between caste, the socioeconomic situation, and the nutritional status in children in Nepal. It could be postulated that interactions between these factors and different customs on the treatment of sick children may pose an explanation for the intercaste differences in children's nutritional status (Anonymous, 1975).

*TABLE 4. Multiple regression analysis of child mortality, caste (low = 0, high = 1), crowding, and altitude with nutritional status of children (Summed Z scores for five parameters)*[1]

| Independent variables | β | *t* | *P* |
|---|---|---|---|
| Child mortality | 0.08 | 1.3 | 0.11 |
| Caste | −0.16 | −3.3 | 0.001 |
| Crowding | −0.16 | −3.3 | 0.001 |
| Altitude | 0.13 | 2.6 | 0.009 |

[1] $R^2 = 0.07$; F ratio (df = 419) = 7.7; $P < 0.0001$.

## The child mortality and sib's nutritional status hypothesis

Male/female ratios of births and deaths in this study could be interpreted as indicating substantial underreporting of female deaths. Mortality rates in the present study (107 and 144 per 1,000 live births between age 0 and <5 years in the high and low caste households, respectively) are moderate in comparison with previously published rates in Nepal (172 and 239 per 1,000, respectively [Unicef, 1985; Carlaw and Vaidya, 1983]). It cannot be ruled out that underreporting of deaths in the interviews seriously affected our findings. However, we found no statistically significant association between child mortality and siblings' nutritional status after correction for caste, crowding, and altitude (Table 4).

In conclusion, our results show very severe growth retardation in native children living at moderate levels of high altitude (1,700–3,000 m) in rural Nepal. Nutritional status is associated with socioeconomic factors such as caste and crowding. Contrary

*APPENDIX. Means (SD) of anthropometric measurements in Koshi Hill area in Nepal*

| | | Height (cm) | | Weight (kg) | | Triceps skinfold (mm) | | Head circumference (cm) | | Arm circumference (cm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Age (years) | n | Mean | (SD) | Mean | (SD) | Mean | (SD) | Mean | (SD) | Mean | (SD) |
| Boys (n = 228) | | | | | | | | | | | |
| 0–0.24 | 8 | 56.2 | (4.3) | 4.9 | (1.3) | 7.7 | (2.3) | 37.7 | (2.4) | 11.1 | (1.7) |
| 0.25–0.49 | 3 | 64.3 | (3.6) | 7.0 | (1.1) | 9.8 | (1.0) | 41.6 | (0.8) | 12.7 | (1.0) |
| 0.5–0.99 | 13 | 69.3 | (3.6) | 7.5 | (0.8) | 7.6 | (1.3) | 44.1 | (1.3) | 12.3 | (1.0) |
| 1–1.99 | 19 | 74.4 | (4.6) | 8.6 | (1.3) | 7.8 | (1.7) | 45.7 | (1.4) | 12.7 | (1.3) |
| 2–2.99 | 16 | 83.0 | (3.2) | 10.6 | (1.0) | 8.4 | (1.2) | 47.8 | (1.4) | 13.6 | (0.9) |
| 3–3.99 | 17 | 88.2 | (3.8) | 11.6 | (1.4) | 7.7 | (2.0) | 48.3 | (1.6) | 13.6 | (1.0) |
| 4–4.99 | 24 | 94.1 | (4.7) | 12.8 | (1.5) | 7.0 | (1.7) | 49.0 | (1.2) | 13.8 | (0.8) |
| 5–5.99 | 14 | 100.7 | (3.9) | 14.5 | (1.9) | 5.8 | (1.0) | 49.5 | (1.1) | 14.0 | (1.3) |
| 6–6.99 | 12 | 109.6 | (3.3) | 16.7 | (1.1) | 5.4 | (1.7) | 50.3 | (0.7) | 14.3 | (0.8) |
| 7–7.99 | 21 | 112.0 | (4.8) | 17.6 | (1.9) | 5.1 | (1.5) | 50.0 | (1.0) | 14.2 | (1.2) |
| 8–8.99 | 14 | 118.4 | (5.5) | 20.3 | (3.5) | 4.9 | (0.9) | 51.1 | (1.7) | 15.0 | (1.4) |
| 9–9.99 | 19 | 119.8 | (4.6) | 20.0 | (1.6) | 4.4 | (0.9) | 50.9 | (1.5) | 14.6 | (0.7) |
| 10–10.99 | 12 | 126.4 | (4.9) | 22.9 | (2.9) | 4.8 | (1.9) | 51.2 | (1.4) | 15.4 | (1.3) |
| 11–11.99 | 6 | 126.8 | (3.9) | 23.3 | (2.3) | 5.2 | (1.3) | 50.6 | (0.9) | 15.4 | (0.8) |
| 12–12.99 | 17 | 132.3 | (7.5) | 27.3 | (3.6) | 5.0 | (1.2) | 51.3 | (1.5) | 16.9 | (0.9) |
| 13–13.99 | 13 | 137.9 | (6.0) | 28.6 | (3.9) | 4.9 | (1.4) | 52.0 | (1.1) | 16.8 | (1.3) |
| Girls (n = 210) | | | | | | | | | | | |
| 0–0.24 | 2 | 59.7 | (1.8) | 5.0 | (0.1) | 8.1 | (0.1) | 38.9 | (2.3) | 11.1 | (0.9) |
| 0.25–0.49 | 4 | 62.1 | (2.4) | 6.2 | (0.8) | 10.1 | (1.6) | 40.8 | (1.4) | 12.7 | (1.6) |
| 0.5–0.99 | 7 | 67.1 | (3.1) | 7.1 | (1.0) | 10.0 | (1.4) | 43.2 | (1.6) | 12.5 | (0.8) |
| 1–1.99 | 16 | 72.9 | (3.9) | 8.0 | (1.3) | 7.3 | (1.8) | 44.9 | (1.3) | 12.2 | (1.4) |
| 2–2.99 | 26 | 82.4 | (4.5) | 10.1 | (1.4) | 8.1 | (1.7) | 46.7 | (1.3) | 13.1 | (1.0) |
| 3–3.99 | 20 | 88.0 | (4.5) | 11.1 | (1.7) | 7.3 | (1.5) | 47.1 | (1.9) | 13.3 | (1.3) |
| 4–4.99 | 11 | 95.9 | (4.9) | 12.7 | (1.9) | 6.0 | (1.0) | 47.9 | (1.4) | 13.4 | (1.0) |
| 5–5.99 | 16 | 101.2 | (5.1) | 14.2 | (1.6) | 6.1 | (0.9) | 48.3 | (1.2) | 13.8 | (0.9) |
| 6–6.99 | 23 | 106.3 | (4.4) | 16.0 | (1.9) | 6.1 | (1.9) | 49.5 | (1.1) | 14.3 | (1.1) |
| 7–7.99 | 14 | 109.4 | (7.2) | 16.2 | (2.4) | 5.4 | (0.9) | 49.0 | (1.3) | 14.3 | (1.2) |
| 8–8.99 | 12 | 116.3 | (5.2) | 18.8 | (1.8) | 5.3 | (1.6) | 49.7 | (1.2) | 14.8 | (0.8) |
| 9–9.99 | 14 | 120.8 | (8.2) | 20.1 | (2.8) | 4.9 | (1.5) | 50.0 | (1.0) | 14.7 | (1.1) |
| 10–10.99 | 15 | 127.5 | (5.3) | 23.5 | (2.9) | 5.1 | (1.3) | 50.9 | (1.7) | 15.9 | (1.0) |
| 11–11.99 | 9 | 132.9 | (9.5) | 26.0 | (5.0) | 4.4 | (0.6) | 51.3 | (2.1) | 16.4 | (1.1) |
| 12–12.99 | 14 | 138.8 | (9.6) | 30.1 | (6.7) | 5.8 | (1.8) | 51.4 | (2.5) | 17.4 | (1.9) |
| 13–13.99 | 7 | 141.1 | (6.3) | 31.1 | (3.8) | 5.5 | (1.2) | 50.8 | (1.3) | 17.3 | (1.0) |

to expectation, lower nutritional status parameters occur in children from higher caste households. The number of dead siblings is not correlated with the nutritional status of surviving siblings. Future studies on the relation between caste, child mortality, parental education, crowding, and childhood growth in lowland and highland populations on the Indian subcontinent should pay attention to the problem of gender discrimination and underreporting of child death and interaction between caste and socioeconomic factors.

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